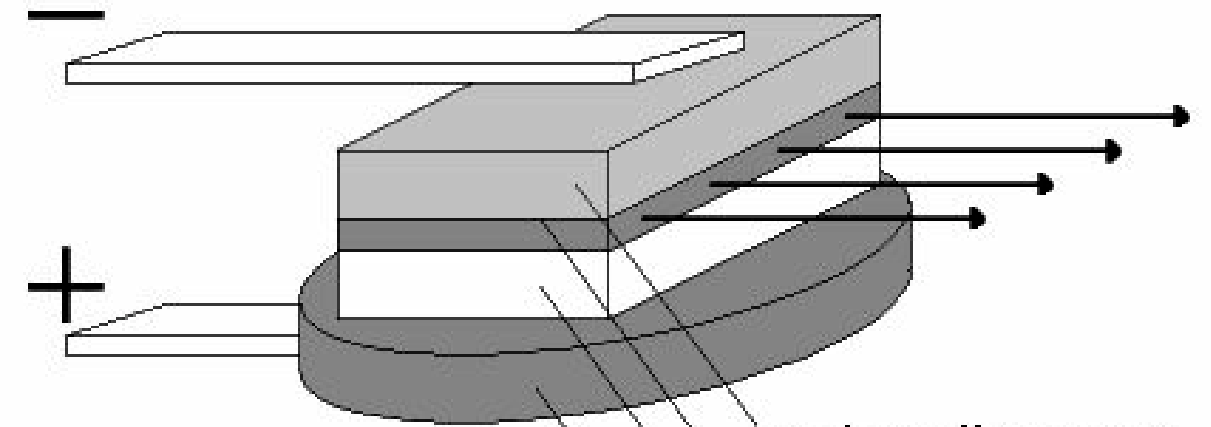


# Narušování symetrie v laserovém rezonátoru

A. Šebek, O. Skála

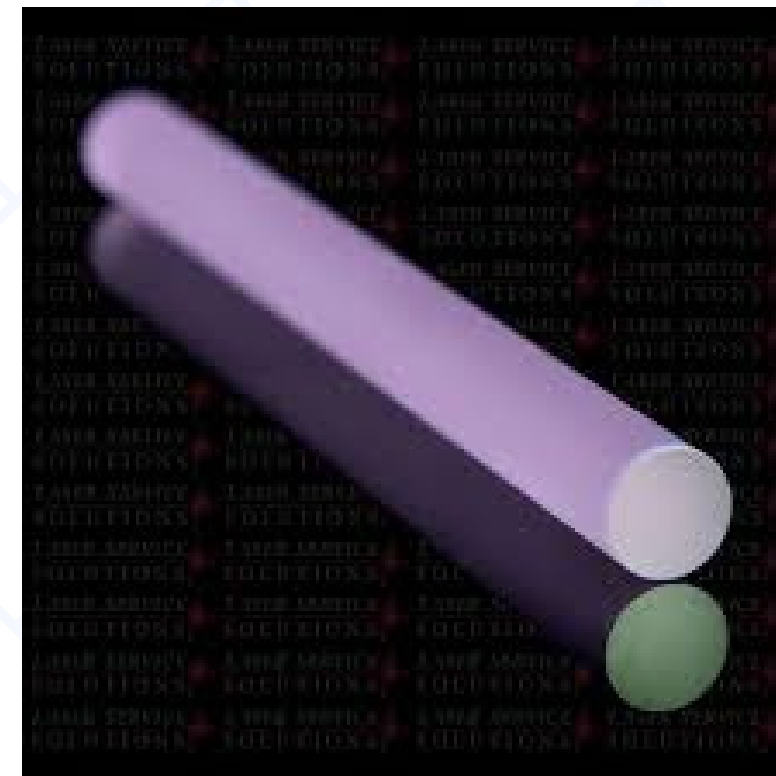
1

# Laser

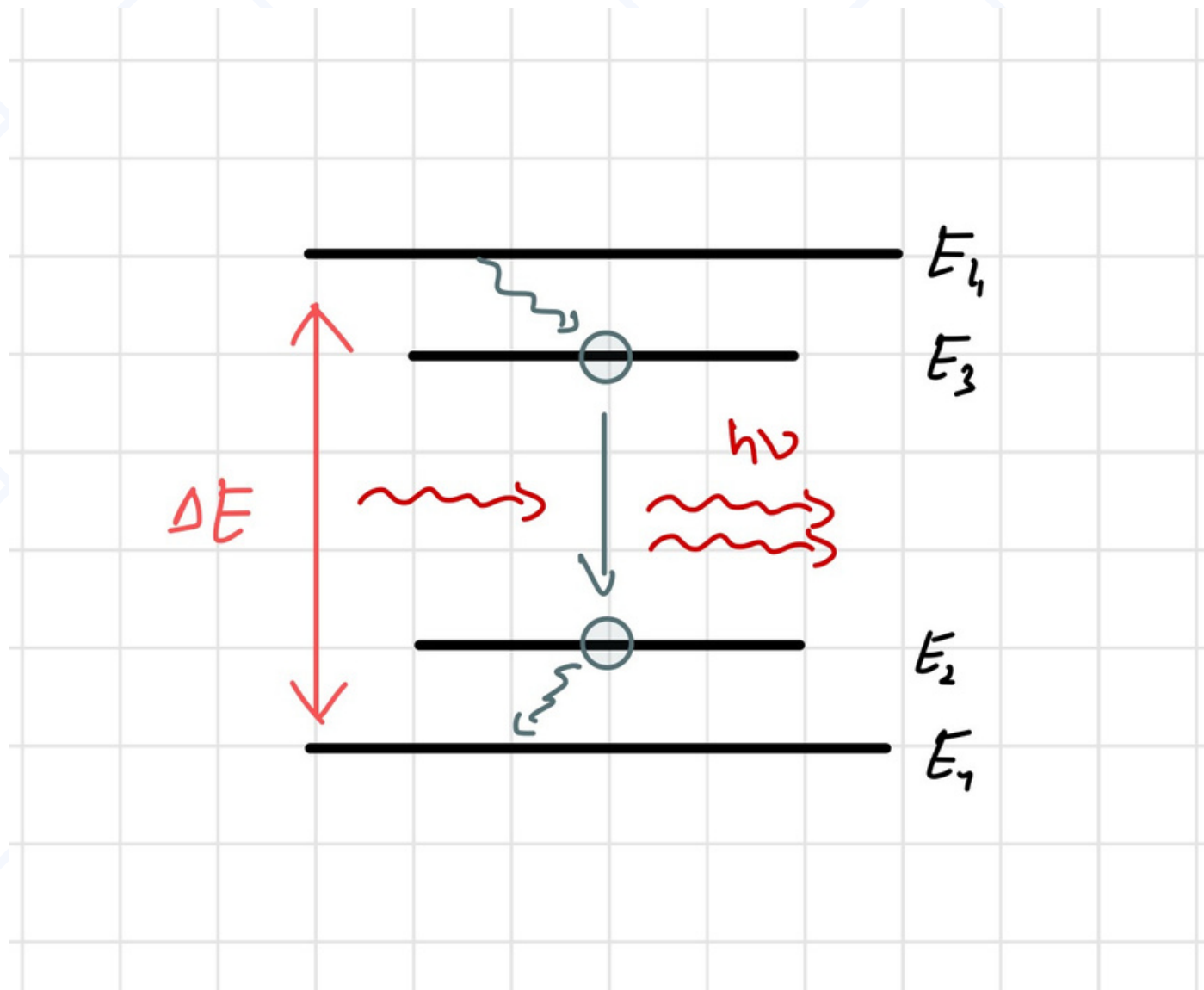


polovodič typu N  
aktivní vrstva - přechod PN  
polovodič typu P  
kovová podložka - chladič

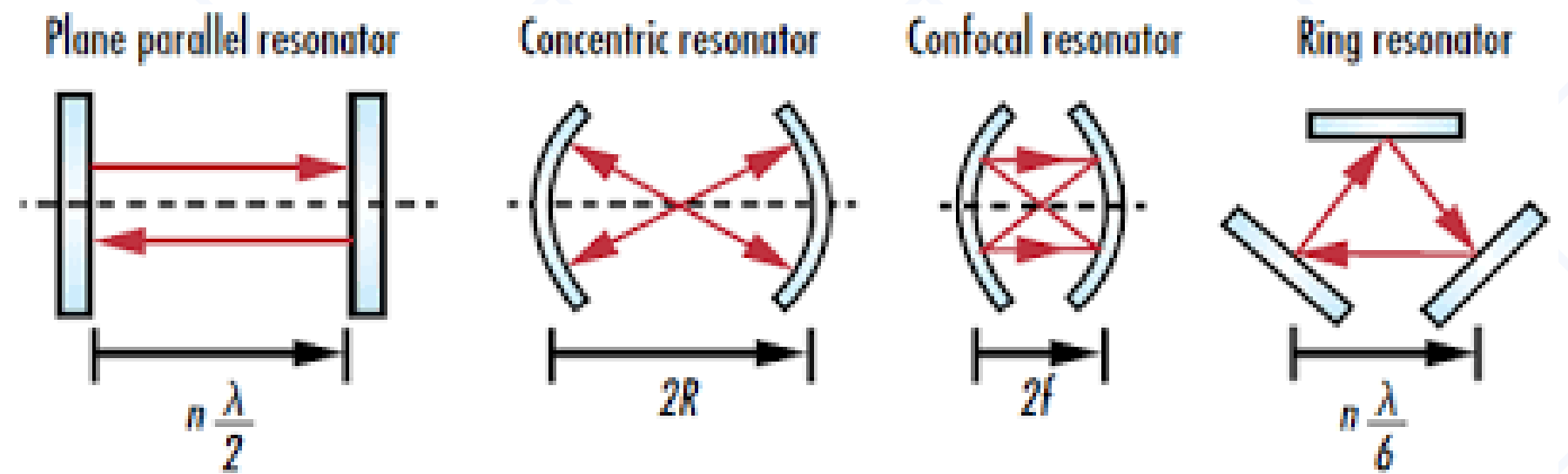
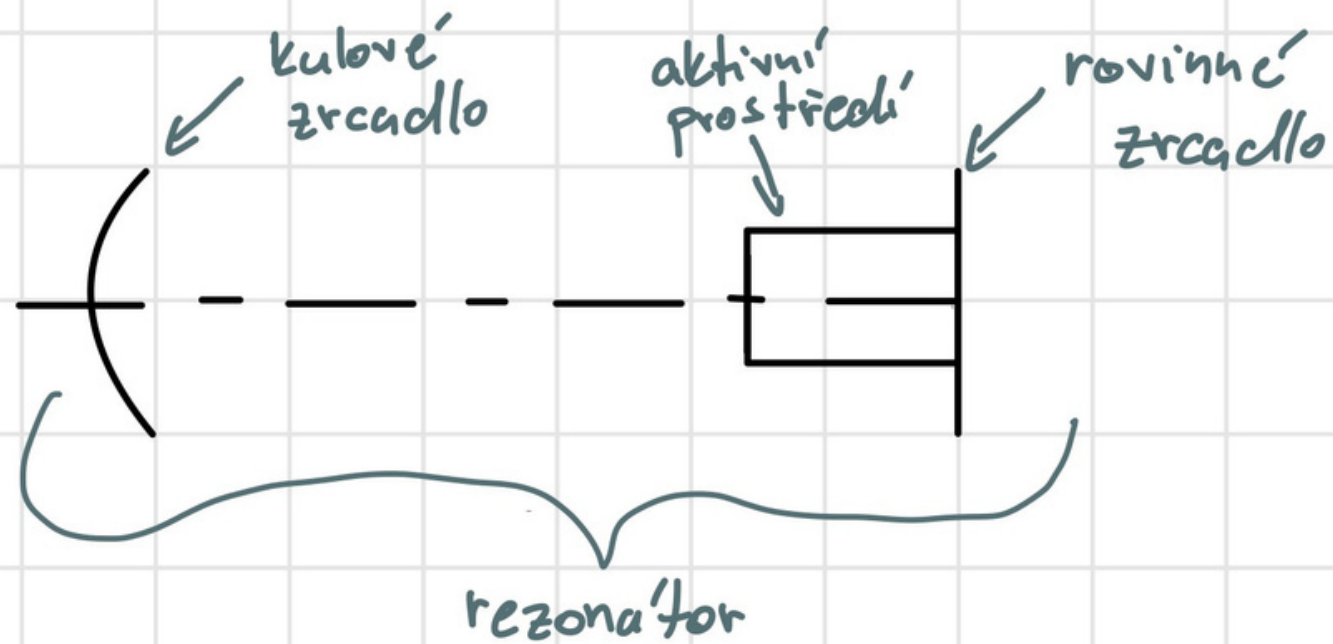
## Polovodičový



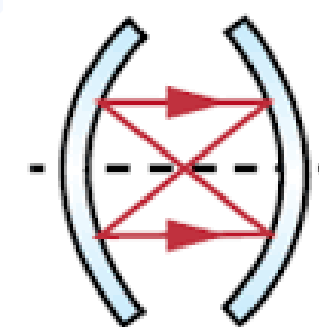
## Krystalový



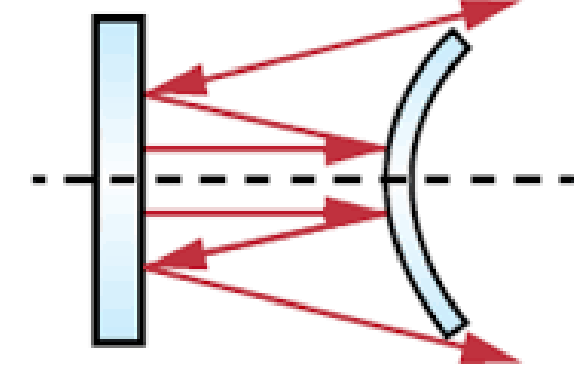
# Rezonator



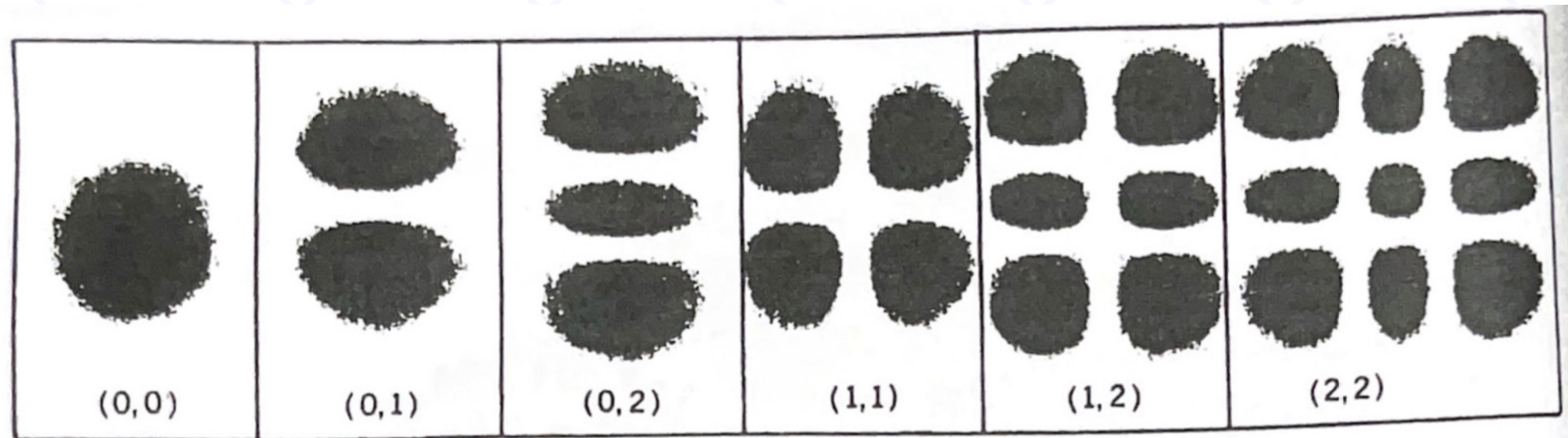
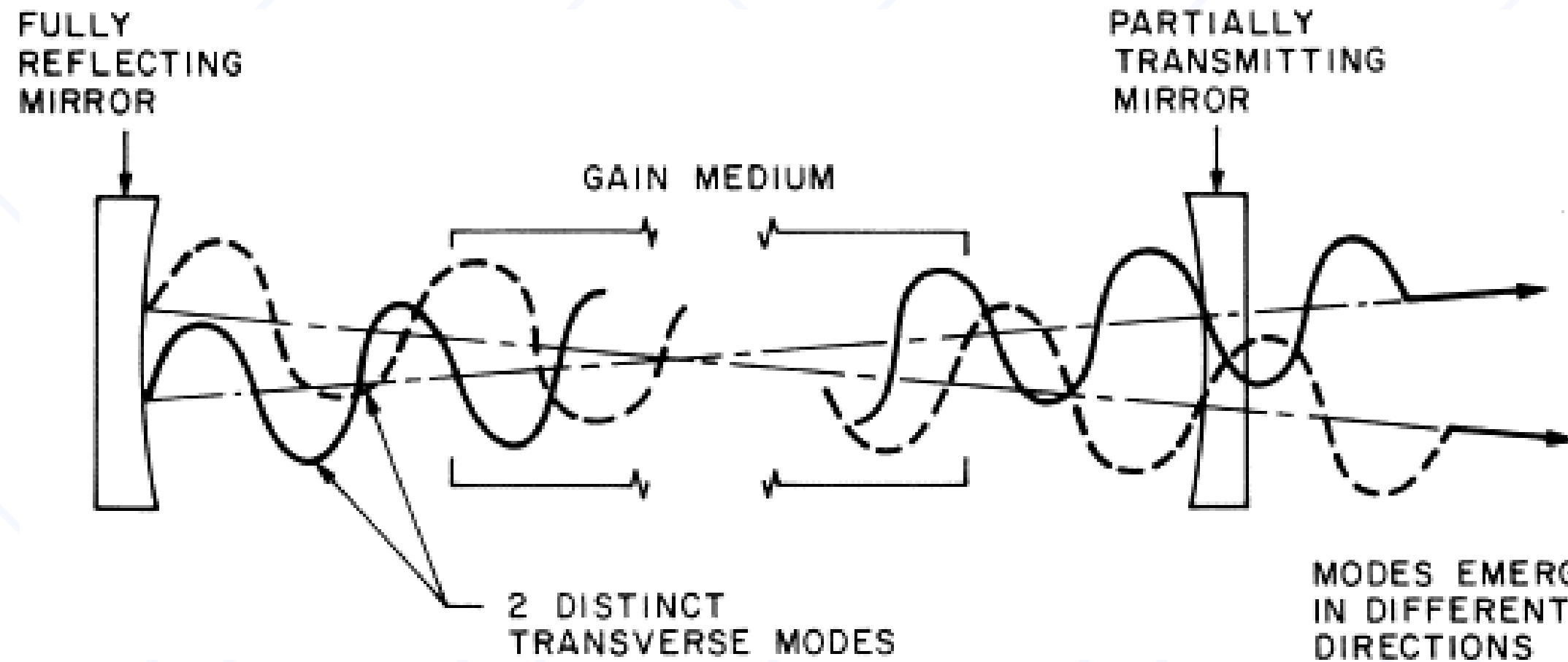
Stable resonator



Unstable resonator



# Symetrie a mody



# Matematika

## Intenzita záření Hermiteovského-Gaussovského svazku

$$I_{l,m}(x, y, z) = |A_{l,m}|^2 \left[ \frac{W_0}{W(z)} \right]^2 G_l^2 \left[ \frac{\sqrt{2}x}{W(z)} \right] G_m^2 \left[ \frac{\sqrt{2}y}{W(z)} \right]$$

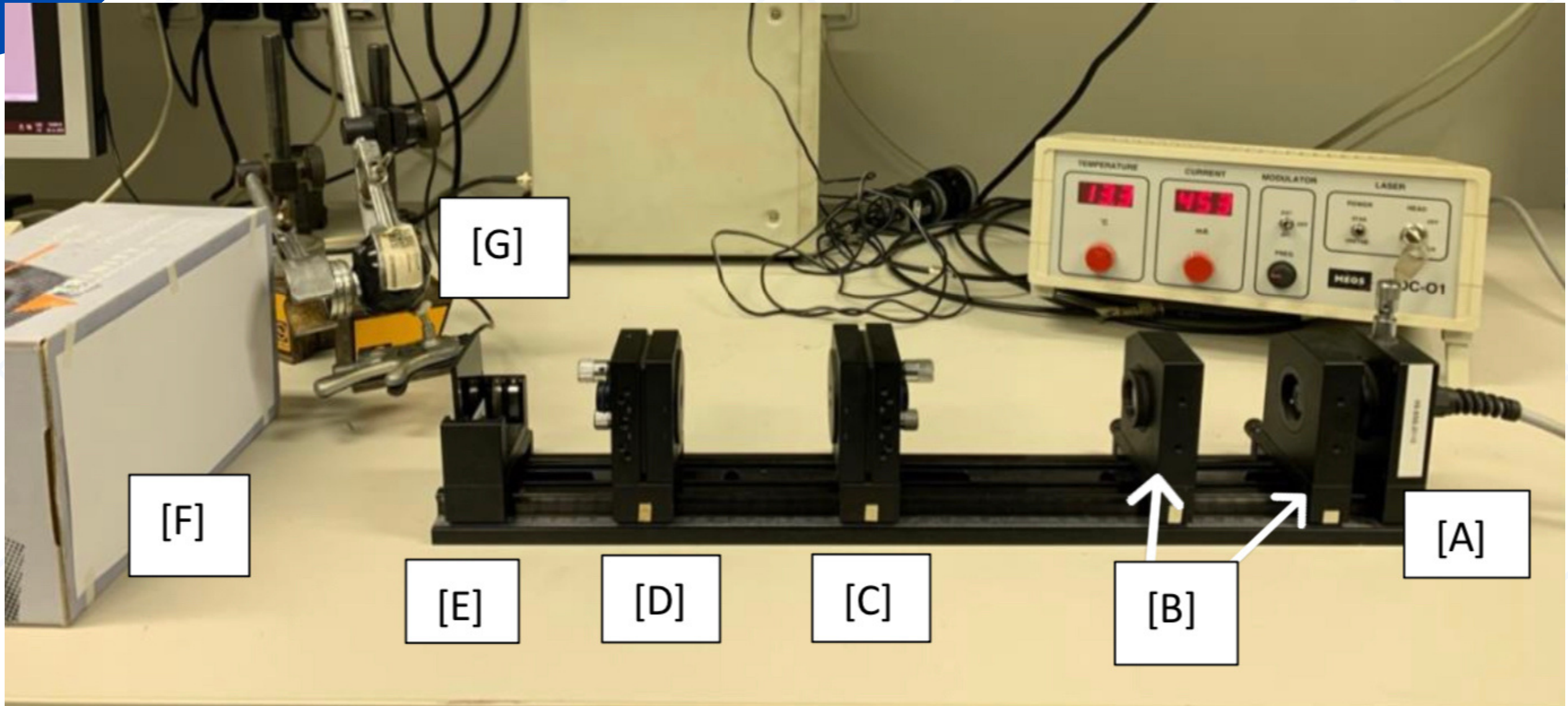
## Stabilita optického rezonátoru

$$g(1,2) = 1 - \frac{L}{r(1,2)},$$

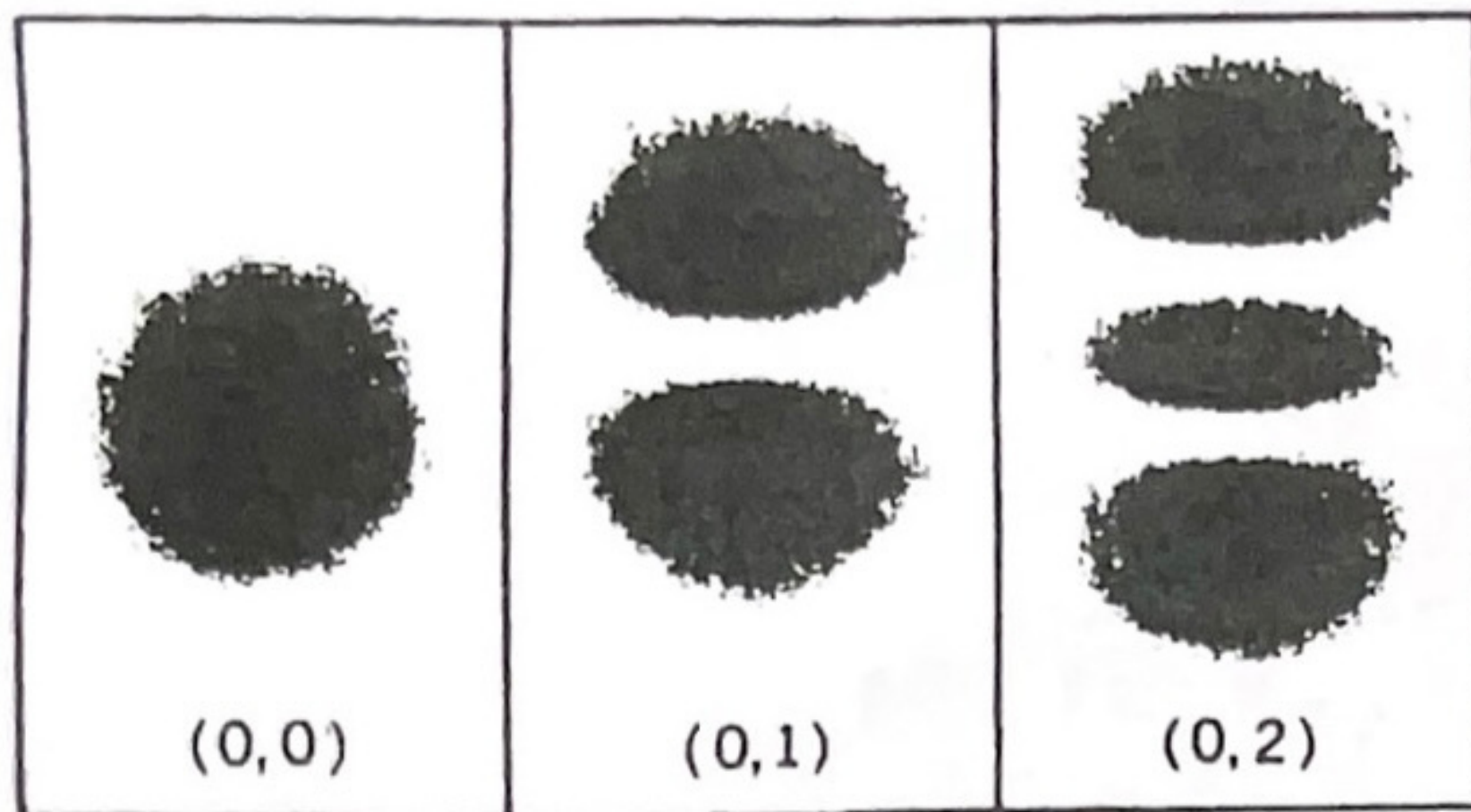
$$0 < g(1) \cdot g(2) < 1$$

5

# Experiment - aparatura



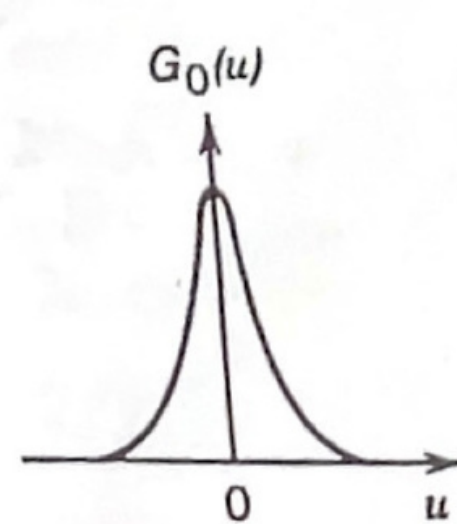
# Příčné rozložení intenzity



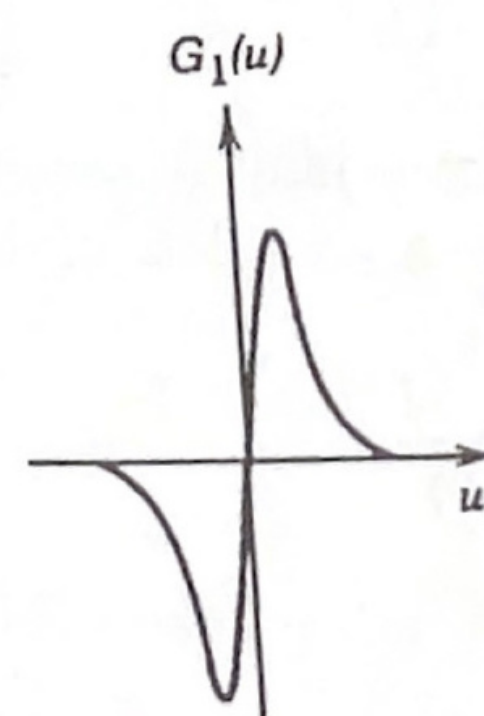
(a)

(b)

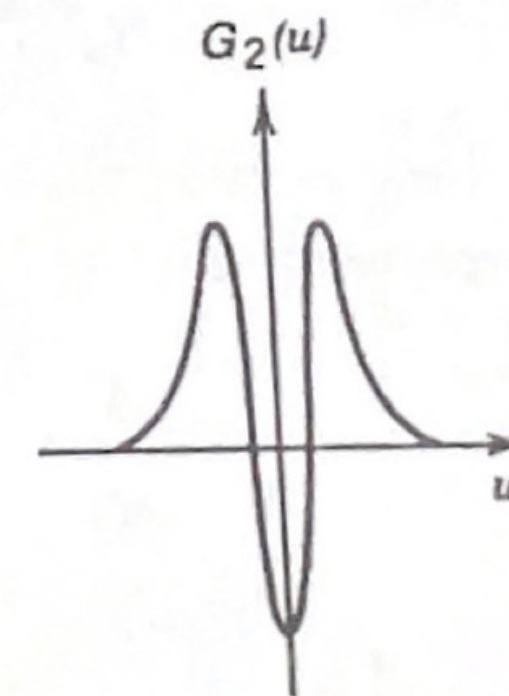
(c)



(a)



(b)



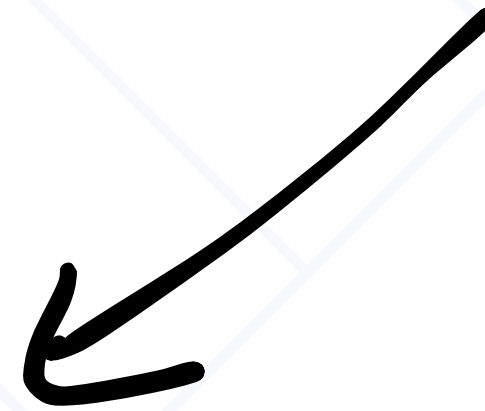
(c)

7

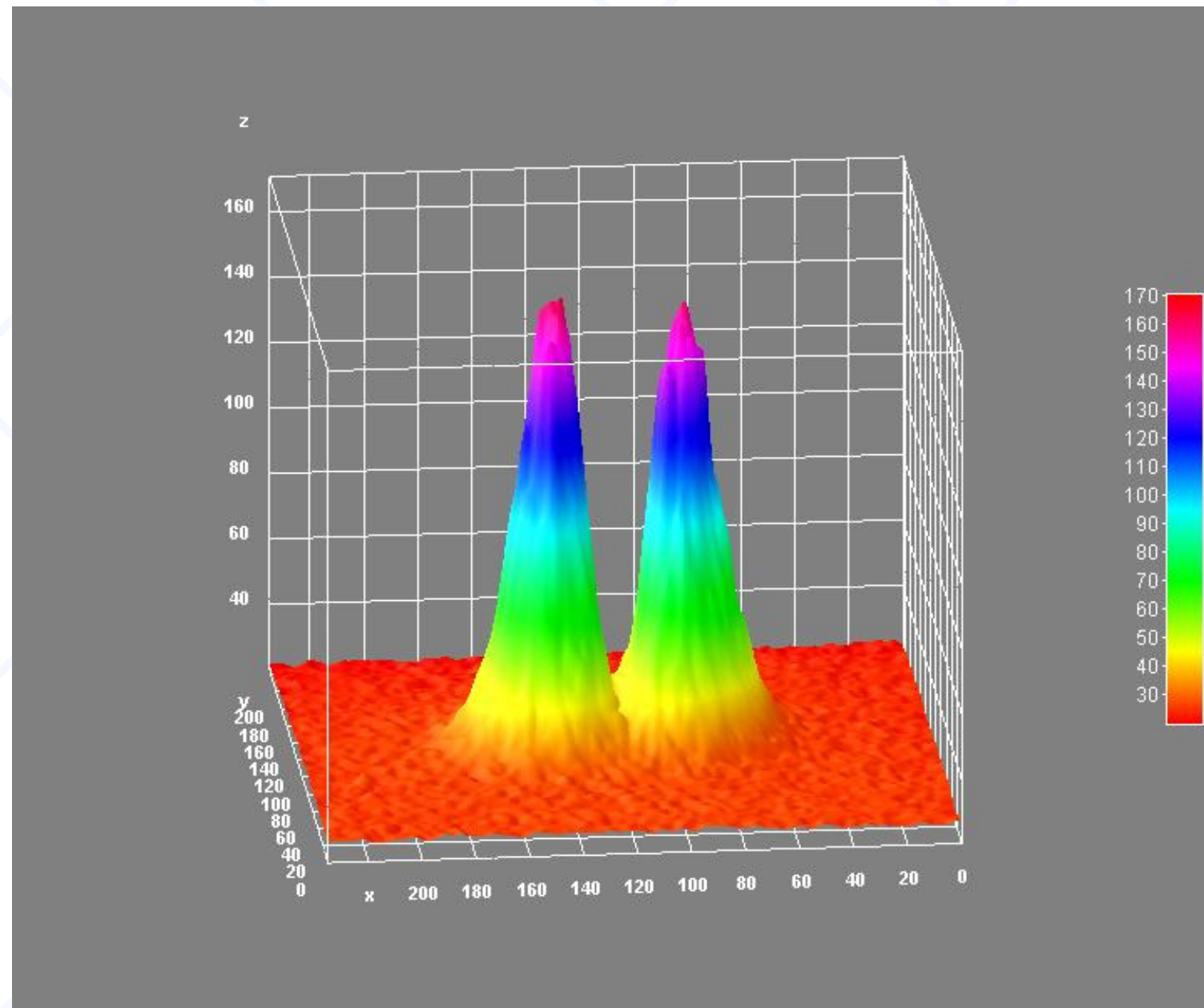
# Měření



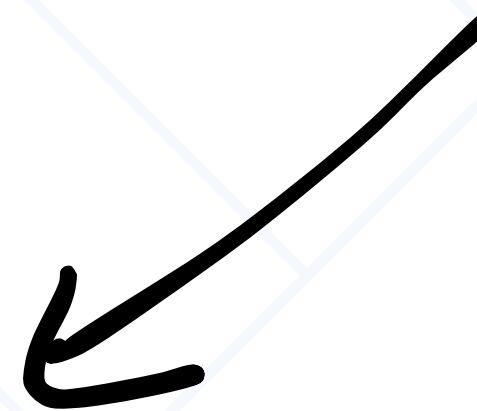
**Data z CCD  
kamery**



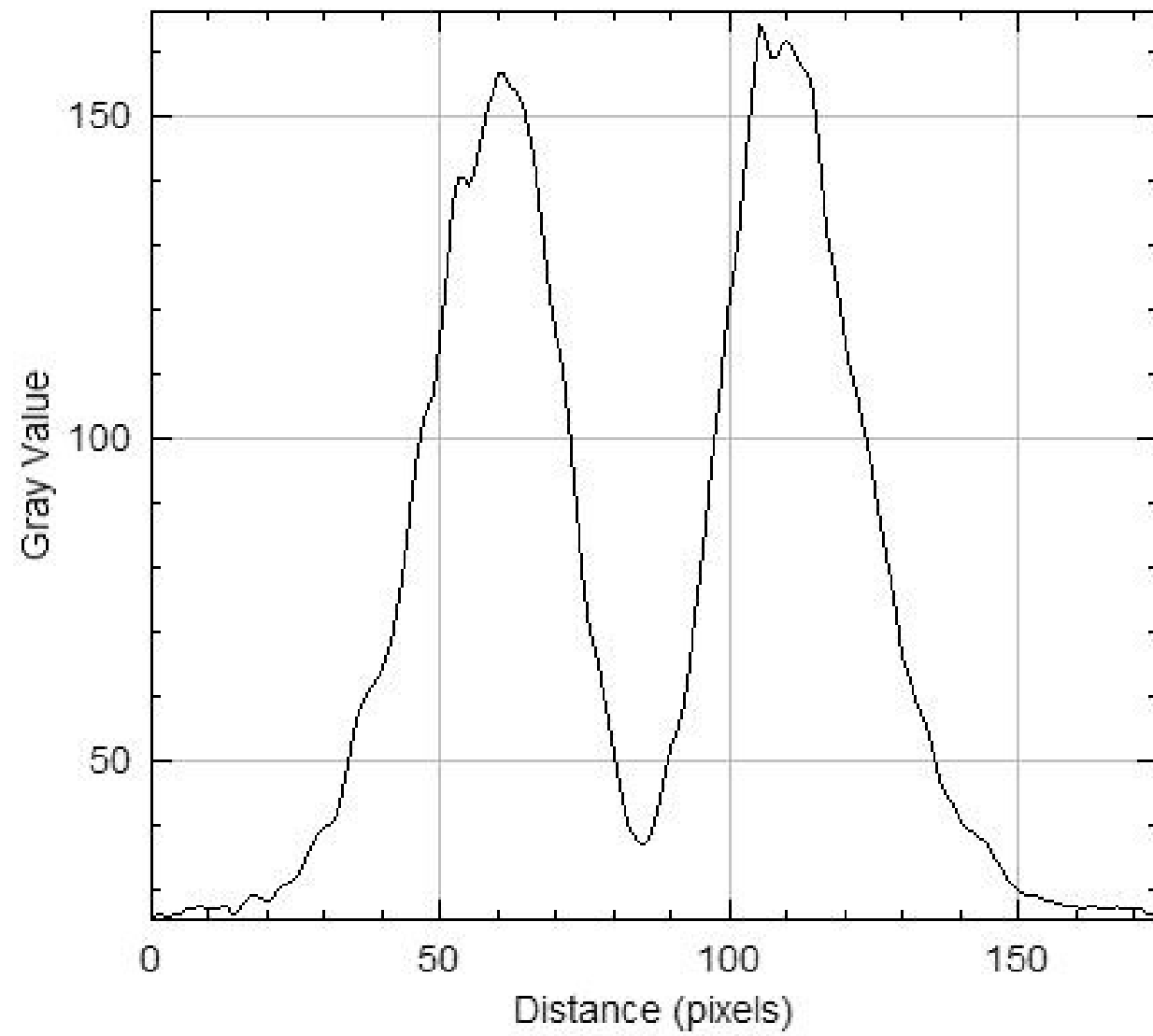




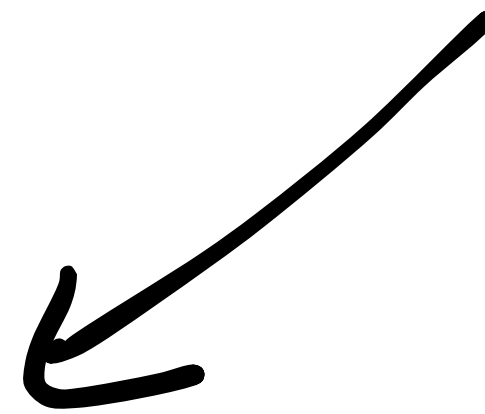
**Vizualizace  
intenzity v 3D  
grafu**



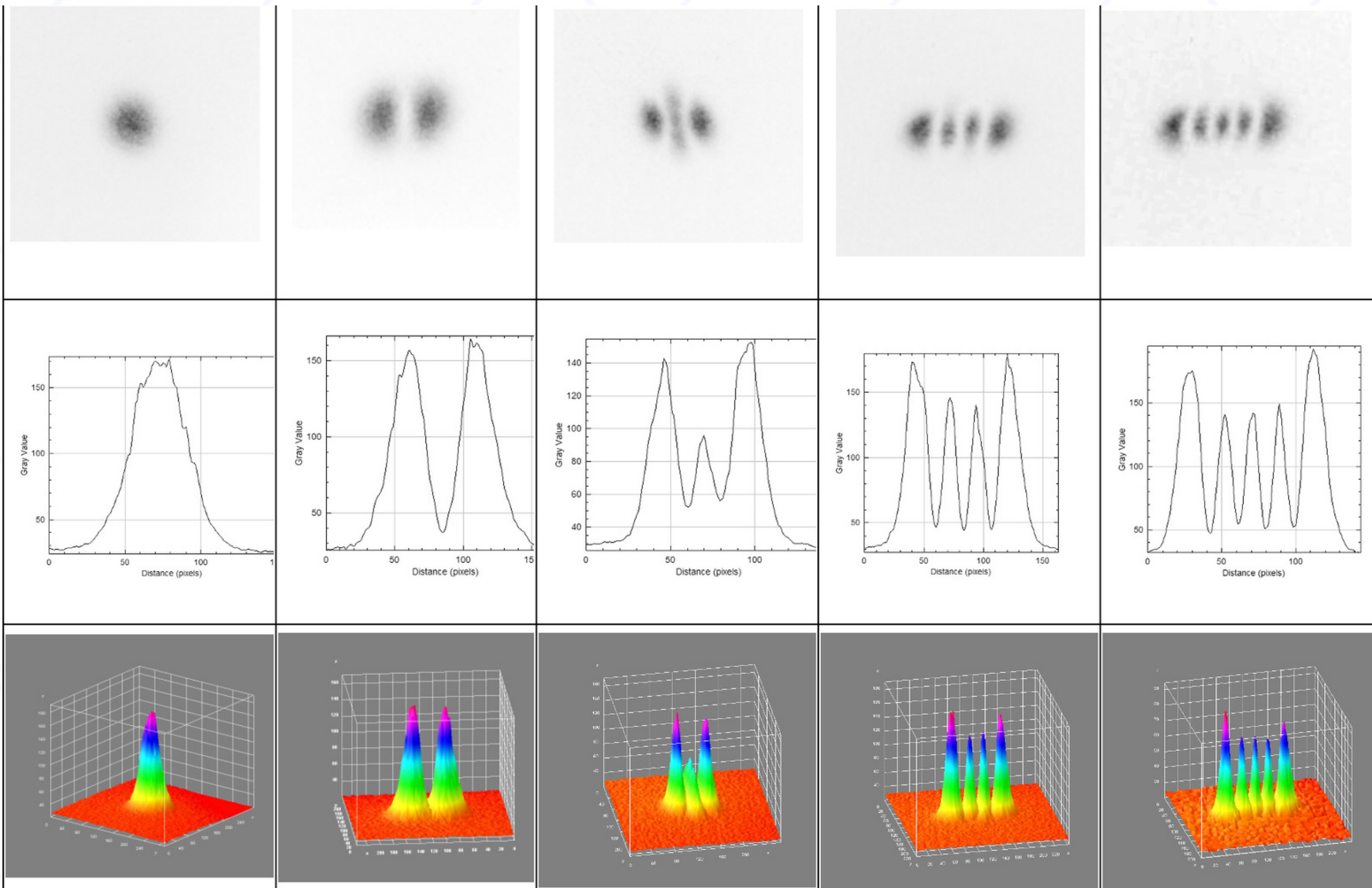
# Měření



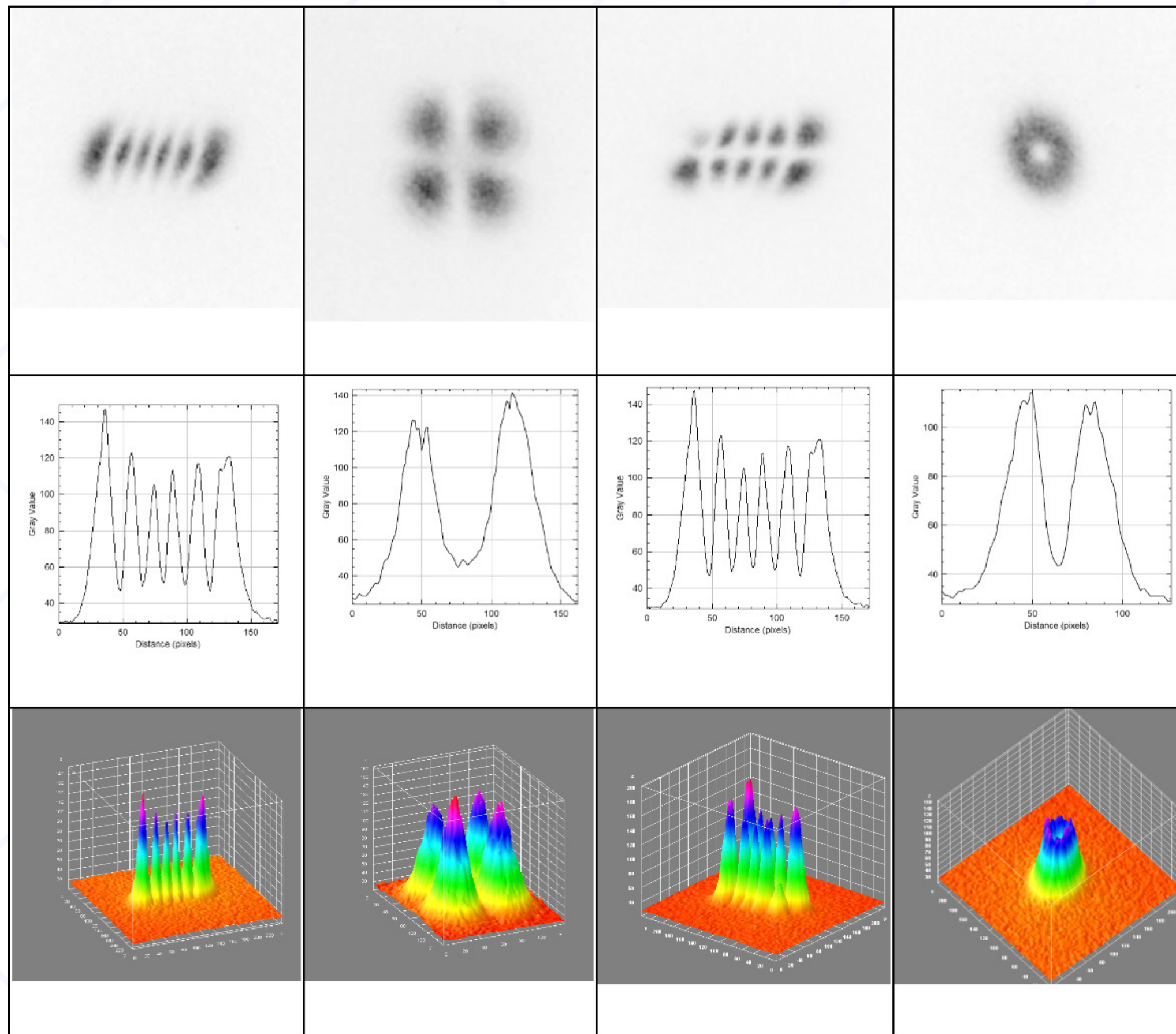
**Řez 3D  
grafem**



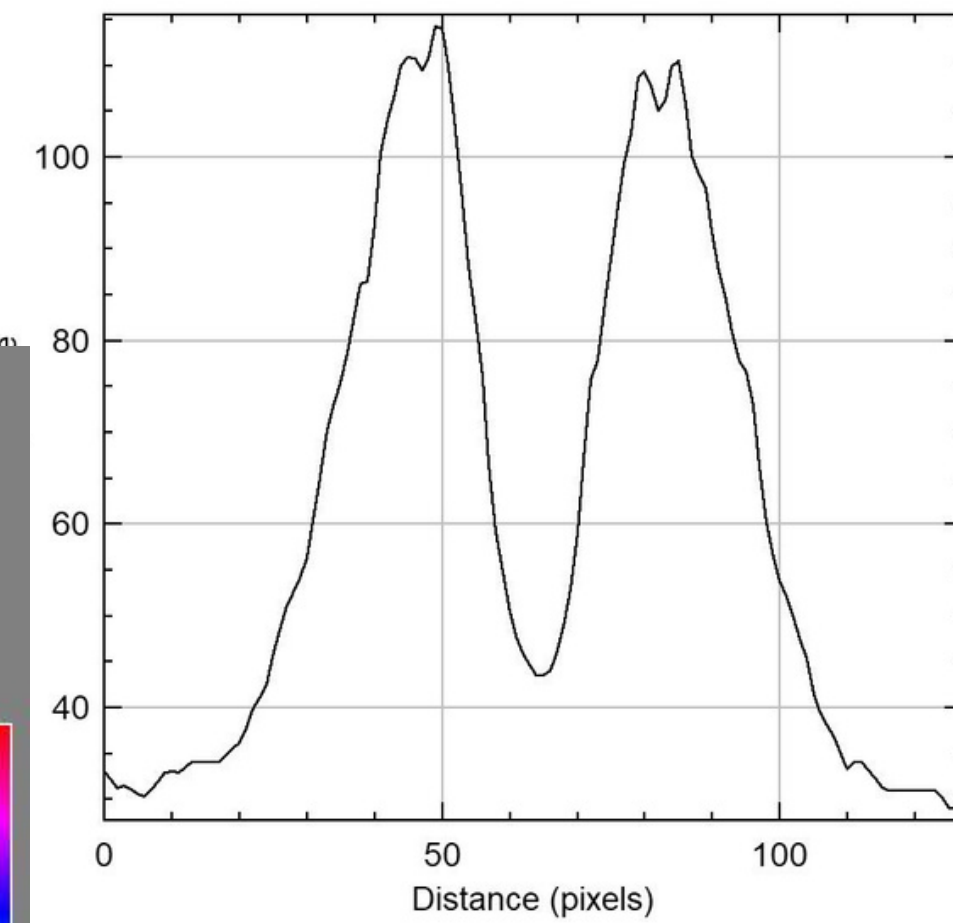
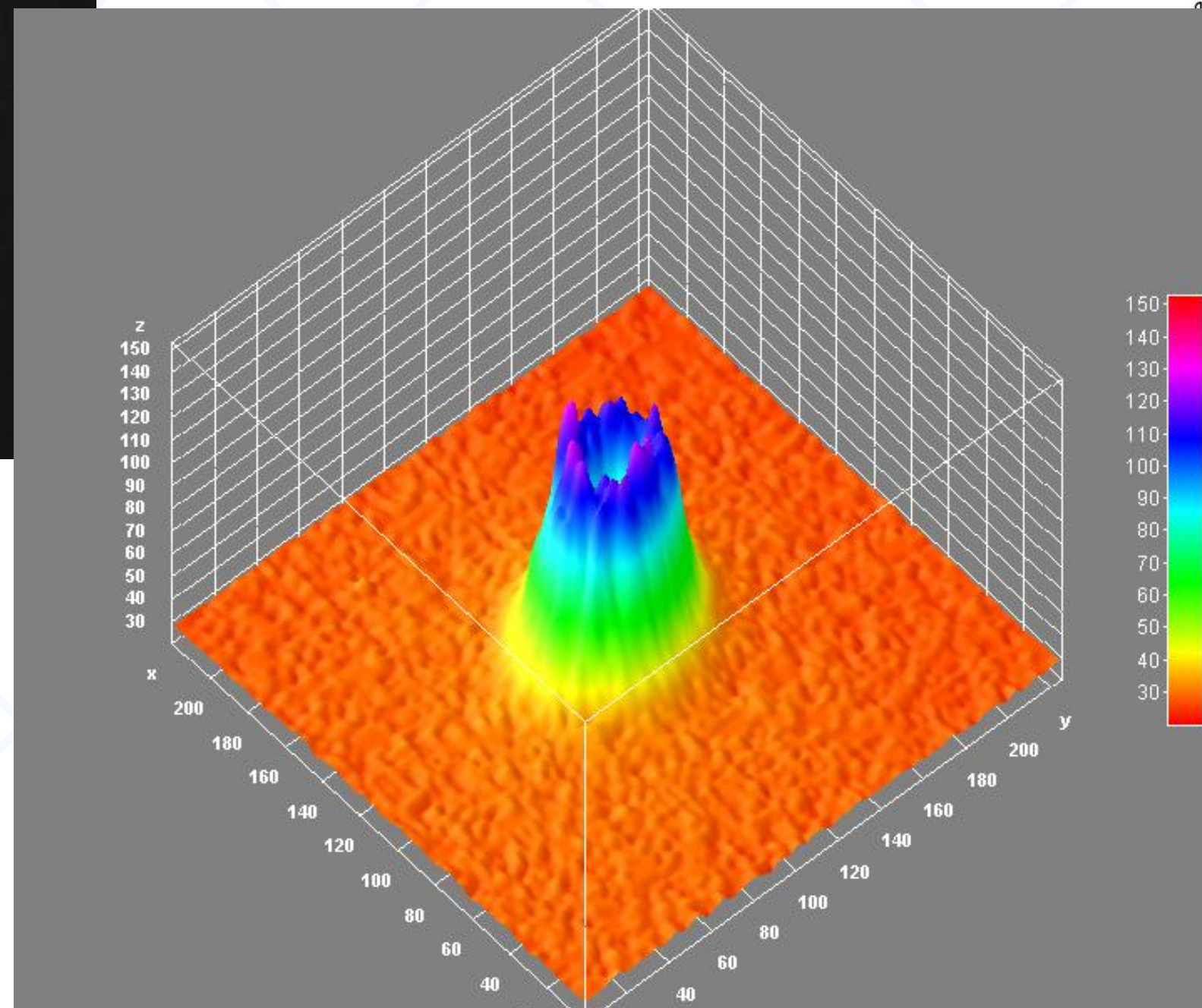
# Sbírka tvarů a patvarů



# Sbírka tvarů a patvarů



# Problematický koblížek



**Laguerovské-  
Gaussovské svazky**

# Závěr a diskuze

- Seznámení s laserem a rezonátorem
- Tvary modu předpovězeny Hermiteovými-Gaussovými funkcemi
- Srovnání teorie s experimentem ?
  
- Změna úhlu a úhlová vzdálenost jasných oblastí řádově odpovídá
- Natáčení kulového zrcadla pomocí dvou šroubů, otáčení v 3D...

# Reference

- 01 SALEH, Bahaa E. A. a Malvin Carl TEICH. Základy fotoniky: Fundamentals of photonics. Praha: Matfyzpress, 1996. ISBN 80-85863-01-4
- 02 Rasband, W.S., ImageJ, U. S. National Institutes of Health, Bethesda, Maryland, USA, <https://imagej.nih.gov/ij/>, 1997-2023

# Děkujeme za pozornost !

